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Water Quality in an Experimental Recirculating Aquaculture System, as Affected by Biofilter Mode of Operation

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Abstract

Biofilter performance and capacity in Recirculating Aquaculture Systems (RAS) is affected by several factors, such as inlet concentrations of specific compounds, but the significance of some of these products to biofilter performance is not well understood. Several studies have demonstrated the differences between biofilter type and mode of operation in terms of nitrogenous substances removal. Yet, few published studies have focused on filter type effects on organic matter balances and particle size distribution, under controlled conditions.

In this study we compared biofilter performance of two types of biofilter: fixed bed (FB) and moving bed (MB) reactors (N=4). The media elements chosen were uniform carrier media (RK Bioelements, 750 $m^2 \cdot m^{-3}$, RK Plast, DK) with two different densities: 1.2kg$\cdot m^{-3}$ for FB and 1.0kg$\cdot m^{-3}$ for MB. All filters were connected to the same system, comprising 5.5m^3 fish tank stocked with rainbow trout (30 kg), a 40µm-drum filter, four trickling filters and four similar biofilters (equal in size, filling rate, specific surface area of media and hydraulic load), was operated under constant conditions (2 kg feed/day and 2 m^{-3} make-up water/day) for more than three months. The cumulative feed burden (CFB) was maintained constant during the whole experimental period, and nitrification rates, organic matter removal and resulting water quality were evaluated at the system and at the individual biofilter levels.

Sequential bypassing of one or the other type of biofilters was conducted under controlled steady-state conditions during a 3 months period. Nitrification performance and capacity of the bypassed biofilters was assessed by Total Ammonia Nitrogen (TAN) and NO_2-N spikes, and effects of biofilter type on resulting water quality parameters (organic matter, particle size distribution, nitrogenous compounds and bacterial abundance) was assessed.

The biofilter type (FB or MB) effect on RAS water quality and performance was studied by sampling pooled 24-hour samples collected at the inlet and outlet of each biofilter. Water samples were analyzed for COD, BOD_5, PSD, dissolved-N (NH_4-N, NO_2-N, NO_3-

N, Urea-N, Total-N) and microbial abundance. Individual grab samples were collected during spiking every 15 minutes, and analyzed for TAN, Urea-N, NO_2-N and NO_3-N in the TAN spiking events and for NO_2-N and NO_3-N in the NO_2-N spiking events.

Data obtained through the execution of the described protocol, reporting nutrient balances in RAS as affected by biofilter mode of operation, will be presented and discussed.